

CLAIMS:

1. A Multi-Stage Preferential Oxidation reactor for substantially removing carbon-monoxide from a product-gas, said reactor comprising:

5 at least one Preferential Oxidation Reactor Stage having a product-gas stream inlet end and a product-gas stream outlet end;

a first inlet means to introduce the product-gas stream into said Preferential Oxidation Reactor Stage, said inlet means located at the product-gas stream inlet end of said Preferential Oxidation Reactor Stage, said first inlet means further configured with a means to pulsate the flow of said product-gas stream into said Preferential Oxidation Reactor Stage;

a second inlet means to introduce an oxidant into said Preferential Oxidation Reactor Stage, said second inlet means located at the product-gas stream inlet end of said oxidizer Preferential Oxidation Reactor Stage; and

an outlet means for removal of the treated product-gas stream from said Preferential Oxidation Reactor Stage, said outlet means located at the outlet end of said reactor.

2 The reactor of claim 1 further comprising a second Preferential Oxidation Reactor Stage having a product-gas stream inlet end and a product-gas stream outlet end, said second

Preferential Oxidation Reactor Stage further configured with a first inlet means to introduce the product-gas stream into said second Preferential Oxidation Reactor Stage, said first inlet means located at the product-gas stream inlet end of said second Preferential Oxidation Reactor Stage, said second Preferential Oxidation Reactor Stage further configured with a second inlet means to introduce an oxidant into said Preferential Oxidation Reactor Stage, said second inlet means located at the product-gas stream inlet end of said oxidizer Preferential Oxidation Reactor Stage, said second Preferential Oxidation Reactor Stage further configured with an outlet means for removal of the treated product-gas stream from said Preferential Oxidation Reactor Stage, said outlet means located at the outlet end of said second reactor and wherein said first inlet means of said second Preferential Oxidation Reactor Stage receives the treated off-gas from said first Preferential Oxidation Reactor Stage.

3. The reactor of claim 2 further comprising a third Preferential Oxidation Reactor Stage having a product-gas stream inlet end and a product-gas stream outlet end, said third Preferential Oxidation Reactor Stage further configured with a first inlet means to introduce the product-gas stream into said third Preferential Oxidation Reactor Stage, said first inlet means located at the

product-gas stream inlet end of said third Preferential Oxidation Reactor Stage, said third Preferential Oxidation Reactor Stage further configured with a second inlet means to introduce an oxidant into said Preferential Oxidation Reactor Stage, said second inlet means located at the product-gas stream inlet end of said oxidizer Preferential Oxidation Reactor Stage, said third Preferential Oxidation Reactor Stage further configured with an outlet means for removal of the treated product-gas stream from said third Preferential Oxidation Reactor Stage, said outlet means located at the outlet end of said third reactor and wherein said first inlet means of said third Preferential Oxidation Reactor Stage receives the treated off-gas from said second Preferential Oxidation Reactor Stage.

4. A Multi-Stage Preferential Oxidation reactor for substantially removing carbon-monoxide from a product-gas, said reactor comprising at least two Preferential Oxidation Reactor Stages, each stage having a product-gas stream inlet end and a product-gas stream outlet end, a first inlet means located at the product-gas stream inlet end of each stage to introduce the product-gas stream into each stage, a second inlet means located at the product-gas stream inlet end of each stage to introduce an oxidant into each stage, an outlet means located at the product-gas stream outlet end

of each stage for removal of the treated product-gas stream from each stage, and wherein said first inlet means of the first stage is further configured with a means to pulsate the flow of said product-gas stream into said first stage and wherein each said stage is located in series-flow configuration with respect to the product-gas.

5. A Multi-Stage Preferential Oxidation reactor for substantially removing carbon-monoxide from a product-gas, said reactor comprising at least two Preferential Oxidation Reactor Stages, each stage having a product-gas stream inlet end and a product-gas stream outlet end, a first inlet means located at the product-gas stream inlet end of each stage to introduce the product-gas stream into each stage, a second inlet means located at the product-gas stream inlet end of each stage to introduce an oxidant into each stage, an outlet means located at the product-gas stream outlet end of each stage for removal of the treated product-gas stream from each stage, and wherein each said stage is located in series-flow configuration with respect to the product-gas and in parallel-flow configuration with respect to the oxidant.

6. The reactor of claim 5 wherein said first inlet means of the first stage is further configured with a means to pulsate the flow

of said product-gas stream into said first stage.

7. The reactor of claim 5 wherein said second inlet means of each stage is further configured with a means to pulsate the flow of said oxidant into said each stage.

8. The reactor of claim 5 further comprising means to connect said second inlet means of each stage to a common source of oxidant.

9. The reactor of claim 8 further comprising means to pulsate the flow of oxidant from the common source of oxidant.

10. The reactor of claim 6 wherein the means to pulsate the flow of product-gas is a flow-control element.

11. The reactor of claim 10 wherein said flow control element is an actuator-operated flow-control valve whose actuator is cyclically driven between two predetermined positions by a pre-programmed control logic.

12. The reactor of claim 10 wherein said flow control element is an actuator-operated flow-control valve whose actuator is

cyclically driven between two predetermined positions by a mechanically linked feed-back system which throttles or opens the flow-control valve in inverse relationship to the pressure of said first feed-gas stream downstream of said flow control element.

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13. The reactor of claim 10 wherein said flow control element is a feedback-loop based flow-control valve whose actuator is cyclically driven between two predetermined positions by incorporating a zero-dampening factor in its feed-back control system.

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14. The reactor of claim 10 wherein said means to pulsate first feed-gas stream component flow is a rotating gas compressor whose rotational speed is cyclically varied within a pre-determined range of operating rotational speeds.

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15. The reactor of claim 10 wherein said means to pulsate first feed-gas stream component flow is a peristaltic flow movement device.

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16. The reactor of claim 9 wherein the means to pulsate the flow of oxidant is a flow-control element.

17. The reactor of claim 9 wherein said flow control element is an actuator-operated flow-control valve whose actuator is cyclically driven between two predetermined positions by a pre-programmed control logic.

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18. The reactor of claim 9 wherein said flow control element is an actuator-operated flow-control valve whose actuator is cyclically driven between two predetermined positions by a mechanically linked feed-back system which throttles or opens the flow-control valve in inverse relationship to the pressure of said first feed-gas stream downstream of said flow control element.

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19. The reactor of claim 9 wherein said flow control element is a feedback-loop based flow-control valve whose actuator is cyclically driven between two predetermined positions by incorporating a zero-dampening factor in its feed-back control system.

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20. The reactor of claim 9 wherein said means to pulsate first feed-gas stream component flow is a rotating gas compressor whose rotational speed is cyclically varied within a pre-determined range of operating rotational speeds.

21. The reactor of claim 9 wherein said means to pulsate first

feed-gas stream component flow is a peristaltic flow movement device.

22. A method of operating a Preferential Oxidation reactor
5 comprising the steps of:

- introducing a product-gas into said reactor;
- introducing an oxidant into said reactor;
- pulsing the flow of the product gas; and
- removing the treated product-gas from said reactor.

10 23. A method of operating a Preferential Oxidation reactor
comprising the steps of:

- introducing a product-gas into said reactor;
- introducing an oxidant into said reactor;
- 15 pulsing the flow of the oxidant; and
- removing the treated product-gas from said reactor.

20 24. A method of operating a Multi-stage Preferential Oxidation
reactor said reactor consisting of at least two Preferential
Oxidation Reactor Stages connected in series flow configuration
with a product-gas, comprising the steps of:

- introducing a product-gas into the first stage of said
reactor;

introducing an oxidant into each said reactor stage;
Pulsing the flow of the product gas; and
removing the treated product-gas from the last reactor stage.

5 25. A method of operating a Multi-stage Preferential Oxidation reactor said reactor consisting of at least two Preferential oxidation Reactor Stages connected in parallel flow configuration with an oxidant, comprising the steps of:

10 introducing a product-gas into the first stage of said reactor;

introducing an oxidant into each said reactor stage;
Pulsing the flow of the oxidant into at least one of said reactor stages; and

15 removing the treated product-gas from the last reactor stage.

20 26. A method of operating a Multi-stage Preferential Oxidation reactor said reactor consisting of at least two Preferential Oxidation Reactor Stages connected in parallel flow configuration with a common source of an oxidant, comprising the steps of:

introducing a product-gas into the first stage of said reactor;

introducing an oxidant into each said reactor stage;
Pulsing the flow of the oxidant from the common source of oxidant;

and

removing the treated product-gas from the last reactor stage.